CLAIMS

1. A power conversion circuit comprising:

a current section comprising switched inductors and configured to produce a boosted output voltage from a voltage source when the current section is operated in a forward direction;

a transformer having a primary winding electrically coupled to said boosted output voltage and a secondary winding; and

a voltage section electrically coupled to the secondary winding and configured to electrically couple to a load, said voltage section comprising a plurality of balancing switches configured to be actively driven to provide a DC voltage to the load and to balance energy between said current section and said voltage section when said power conversion circuit is in a no-load condition and operated in the forward direction.

2. A power conversion circuit in accordance with Claim 1 wherein said current section comprises switched circuit branches, each said branch having at least one said switched inductor and a branch switch, and further comprising a control circuit configured to drive said branch switches and said plurality of balancing switches.

3. A power conversion circuit in accordance with Claim 2 wherein a first subset of said plurality of balancing switches is driven in a complementary fashion to a first subset of said branch switches.

4. A power conversion circuit in accordance with Claim 2 wherein each of a plurality of subsets of said plurality of balancing switches is driven in a complementary fashion to a corresponding one of a plurality of subsets of said branch switches.

5. A power conversion circuit in accordance with Claim 1 further comprising a common ground, and wherein said current section is electrically connected to said common ground and said voltage section is electrically isolated from said common ground.

6. A power conversion circuit in accordance with Claim 1 further comprising the voltage source, and wherein said voltage source is a rechargeable battery.

7. A power conversion circuit in accordance with Claim 6 further comprising the load, and wherein said load comprises a fuel cell electrically coupled to the voltage section and configured to receive an initial operating voltage therefrom.

8. A power conversion circuit in accordance with Claim 7 wherein said current section is configured to operate as a rectifier in a reverse direction when said fuel cell is operating, and said voltage section is configured to operate as a buck converter in a reverse direction when said fuel cell is operating, to recharge said rechargeable battery.

9. A power conversion circuit in accordance with Claim 8 further comprising a common ground, and wherein said current section is electrically connected to said common ground and said voltage section is electrically isolated from said common ground.

10. A power conversion circuit in accordance with Claim 9 wherein the common ground is a vehicle chassis or portion thereof.

11. A power conversion circuit in accordance with Claim 8 wherein said current section comprises switched circuit branches, each said branch having at least one said switched inductor and a branch switch, and further comprising a control circuit configured to drive said branch switches and said plurality of balancing switches.

12. A power conversion circuit in accordance with Claim 11 wherein a first subset of said plurality of balancing switches is driven in a complementary fashion to a first subset of said branch switches.

13. A power conversion circuit in accordance with Claim 11 wherein each of a plurality of subsets of said plurality of balancing switches is driven in a complementary fashion to a corresponding one of a plurality of subsets of said branch switches.

14. A power conversion circuit comprising:

a current section configured to receive a input voltage from a voltage source at a first node and common ground, said current section having a pair of switched circuit branches each comprising an inductor and a branch switch and configured to boost a voltage from the current source when the current section is operated in a forward direction;

a transformer having a primary winding and a secondary winding, said primary winding configured to receive said boosted voltage from said current section when said current section is operated in the forward direction, and wherein said secondary winding is electrically isolated from said common ground; and

a voltage section coupled to said transformer, isolated from said common ground, and configured to electrically couple to a load, said voltage section including a plurality of actively-driven balancing switches configured to balance energy between said current section and said voltage section when said voltage section is operated in the forward direction and said power conversion circuit is operated in a no-load condition.

15. A power conversion circuit in accordance with Claim 14 further comprising a control circuit configured to switch said switched circuit branches and to actively drive said plurality of balancing switches.

16. A power conversion circuit in accordance with Claim 15 wherein a first subset of said plurality of balancing switches is driven in a complementary fashion to a first subset of said branch switches.

17. A power conversion circuit in accordance with Claim 15 wherein each of a plurality of subsets of said plurality of balancing switches is driven in a complementary fashion to a corresponding one of a plurality of subsets of said branch switches.

18. A power conversion circuit in accordance with Claim 17 wherein said current section is configured to operate as a rectifier when operated in a reverse direction and said voltage section is configured to operate in a buck mode when operated in the reverse direction.

19. A power conversion circuit in accordance with Claim 18 wherein the voltage source is rechargeable and the power conversion circuit includes said rechargeable voltage source.

20. A power conversion circuit in accordance with Claim 19 wherein the load comprises a fuel cell, and the power conversion circuit includes said fuel cell.

21. A power conversion circuit in accordance with Claim 20 wherein said voltage section is configured to apply an initial voltage to the fuel cell when operated in the forward direction, and to recharge the voltage source from the fuel cell when operated in the reverse direction.

22. A method for operating a power converter circuit having a current section, a transformer, and a voltage section, the current section having a plurality of switched inductors and branch switches and the voltage section having a plurality of balancing switches; said method comprising:

utilizing the branch switches to switch the switched inductors to generate a boosted voltage from a voltage source;

applying the boosted voltage to a primary winding of the transformer to produce a transformed voltage;

coupling a transformed voltage from a secondary winding of the transformer to a balancing section configured to provide power to a load; and

actively driving the balancing switches in the voltage section to rectify the transformed voltage applied to the load, and to balance energy between the current section and the voltage section when the power converter circuit is operated in a no-load condition and in a forward direction.

23. A method in accordance with Claim 22 further comprising operating a control section to actively drive the balancing switches and to switch said branch switches.

24. A method in accordance with Claim 23 wherein said operating the control section comprises driving a first subset of the balancing switches in a complementary fashion to a first subset of the branch switches.

25. A method in accordance with Claim 23 wherein said operating the control section comprises driving each of a plurality of subsets of the balancing switches in a complementary fashion to a corresponding one of a plurality of subsets of the branch switches.

26. A method in accordance with Claim 22 further comprising operating the current section and the voltage section in a reverse direction, and operating the voltage section in a buck mode and the current section as a rectifier when operated in the reverse direction.

27. A method in accordance with Claim 26 further comprising recharging the voltage source when operating the current section and the voltage section in the reverse direction.

28. A method in accordance with Claim 27 further comprising utilizing the rectified, transformed voltage to apply a starting voltage to a fuel cell.

29. A method in accordance with Claim 28 performed in a vehicle.

30. A method in accordance with Claim 28 further comprising operating a control section to actively drive the balancing switches and to switch said branch switches.

31. A method in accordance with Claim 30 wherein said operating the control section comprises driving a first subset of the balancing switches in a complementary fashion to a first subset of the branch switches.

32. A method in accordance with Claim 30 wherein said operating the control section comprises driving each of a plurality of subsets of the balancing switches in a complementary fashion to a corresponding one of a plurality of subsets of the branch switches.